

THE RELATIONSHIP OF THE LACERTILIAN GENUS ANNI-  
ELLA, GRAY.

By G. BAUR, PH. D.

Assistant Professor of Paleontology, University of Chicago.

THE GENUS *Anniella* was created by Gray\* in 1852. It was based on a specimen collected by J. O. Goodridge, Surgeon R. N., in California, and placed among the Scincidæ, section Siaphosinæ, near *Soridia tneata*, Gray (*Lygosoma præpeditum*, Boulenger). The species was called *Anniella pulchra*, Gray.

In 1864 Prof. E. D. Cope† established a special family for this genus under the name of Anniellidæ, which, together with the Aelytropidæ and Acontidæ, was placed in the tribe Typhlopthalmi.

The characters given were the following: †

TYPHLOPHTHALMI.

- Temporal bone [squamosal] superior plate elongate.
- Arches incomplete or wanting.
- Articular and angular confluent. Suspensoria one or two.
- Dentary, inferior process elongate.
- Premaxillary single or double.
- Clavicles very slender, transverse rudimentary or wanting.
- Mesosternum and other sternal pieces wanting.
- Tongue squamous or papillose, simple.—ANELYTROPIDÆ, ACONTIDÆ, ANIELLIDÆ.

The families of the tribe Typhlopthalmi were thus characterized:

- α Two suspensoria; nostril in the rostral shield. Tongue squamous.  
Eye concealed by epidermis; occipital segment loosely attached. No frontal under-arch.....ANELYTROPIDÆ
- Eye distinct; occipital closely articulated; two premaxillaries.....ACONTIDÆ
- β One suspensorium; nostril in a nasolabial plate; tongue papillose.  
Eye distinct; occipital closely articulated; one premaxillary; an inferior frontal arch.....ANIELLIDÆ

\*GRAY, J. E.—Descriptions of several new genera of reptiles, principally from the collection of H. M. S. *Herald*. Ann. Mag. Nat. Hist., 2 ser., x, 1852, p. 440.

†COPE, E. D.—On the characters of the higher groups of Reptilia Squamata and especially of the Diploglossa. Proc. Acad. Nat. Sci. Philadelphia, 1864, pp. 228-230.

‡I have to thank Dr. Leonhard Stejneger for a copy of these notes, the Proceedings of the Philadelphia Academy being not at hand.

The Anelytropidæ contain *Typhlosaurus*, *Feylinia*, (and *Anelytrops*); the Acontidæ the genus *Acontias*; the Anniellidæ the genus *Anniella*. Cope continues:

The remarkable genus *Anniella* lacks the squamosal [quadratojugal] and columella, and has a single premaxillary. The parietal is continuous with the superior plate of the temporal [squamosal], and is much decurved toward the sphenoid; the frontal encloses the olfactory lobes below; these characters are the most amphibænian in the order. There are small pre- and postfrontal bones, and a slender ligamentous postorbital arch. I have as yet found no sternal pieces, and the splenio-mental groove is closed, as in *Acontias*.

The same view is held by Cope\* in 1871 and 1875.

Boulenger† in 1884 adopted the families Anniellidæ and Anelytropidæ, but united the Acontidæ with the Scincidæ.

The Anniellidæ are placed between the Anguidæ and Helodermatidæ, and the following characters are given:

No interorbital septum, no columella cranii, no arches.

The year following the family was characterized thus: ‡

Teeth large, few, fang-like, with short swollen base. Palate toothless. Skull approaching the Ophidian type, i. e., lacking the præ-sphenoidal vacuity and consequently the interorbital septum, and the bones which constitute the brain-case firmly united; no columella cranii, no squamosal; postorbital arch ligamentous; pterygoids in contact with sphenoid; an infraorbital fossa; premaxillary single; nasal and frontal divided; parietal single; præ- and postorbital in contact, separating the frontal from the border of the orbit; scales soft.

Of *Anniella*, he says:

It appears to be a strongly degraded form of the Anguidæ, similarly as the Anelytropidæ and Dibamidæ are to the Scincidæ.

Gill,§ reviewing Boulenger's classification of the Lacertilia, places the Anniellidæ in a superfamily Annielloidea, between the Helodermatidæ and Anguidæ.

Shortly after, Cope|| created for the Anniellidæ a special suborder, *Anguisauri*, which he placed after the *Typhlophthalmi*, in a special group, including the *Opheosauri* (*Amphisbæniæns*). The characters of this group were given as "Prootic bone produced beyond arched body; one suspensorium (=opisthotic [squamosal]) wanting; pelvic arch rudimentary or wanting," and the characters of the *Anguisauri*: "Frontal bone underarching olfactory lobes; supraoccipital gomphosis internal,

\* COPE, E. D.—On the homologies of some of the cranial bones of Reptilia and on the systematic arrangement of the class. Amer. Assoc. Adv. Science, XIX, 1871, p. 237.

COPE, E. D.—Check-list of North American Batrachia and Reptilia. Bull. U. S. Nat. Mus., I, p. 44. 1875.

† BOULENGER, G. A.—Synopsis of the families of the existing Lacertilia. Ann. Mag. Nat. Hist. (5), XIV, London, 1884, pp. 117-122.

‡ BOULENGER, G. A.—Catalogue of Lizards in the British Museum, II, pp. 299-300.

§ GILL, TH.—Annual Report of the Board of Regents of the Smithsonian Inst. to July, 1885, Part I, pp. 799-801. 1886.

|| COPE, E. D.—Catalogue of the Batrachians and Reptiles of Central America and Mexico. Bull. U. S. Nat. Mus., XXXII, 1887, pp. 25-26.

no orbitosphenoid." Nothing is added to the family characters of the Anniellidæ.

The same view is held in 1889\* and in 1891.† Gill's name Anielloidea is substituted for Anguisauri.

In 1892 Cope‡ gave a description of the osteology of Anniella, figuring the skull, hyoid and pelvic arch, and reaches the following conclusion:

The further knowledge of its [Anniella's] structure brings out more clearly its true position. This is, I think, in the Annullati or Amphisbænia. The characters which indicate this reference are: (1) The continuity of the parietal with the petrosal and supraoccipital elements. (2) The absence of epipterygoid. (3) The absence of ceratohyal elements. (4) The hypophyses of the cervical vertebrae, which are continuous with the centra. (5) The partially open chevron bones, which are also continuous with the centra. (6) The sublongitudinal ileopectineal bone and absence of other pelvic elements.

He now places the Anniellidæ as a very distinct family among the Amphisbænia.

We have therefore the following views in regard to the systematic position of Anniella:

1852. Gray: *Anniella* belongs to the Scincidæ and is closely related to *Sordia lineata*, Gray.

1864, 1871, 1875. Cope: *Anniella* is the representative of a special family Anniellidæ, which, together with the Anelytropidæ and Acontiidæ, forms a special tribe of the Lacertilia.

1884, 1885. Boulenger: The *Anniellidæ* form a family between the *Anguidæ* and *Helodermatidæ*; *Anniella* seems to be a strongly degraded form of the *Anguida*.

1886. Gill: The *Anniellidæ* have to be placed in a distinct superfamily *Annielloidea*, between the *Anguidæ* and the *Helodermatidæ*.

1887, 1889. Cope: The *Anniellidæ* belong to a special suborder *Anguisauri*; the *Anguisauri* and *Opheosauri* (Amphisbænia) constitute a natural group of the Lacertilia.

1891. Cope: The name *Anielloidea*, Gill is substituted for *Anguisauri*.

1892. Cope: The *Anniellidæ* form a very distinct family of the *Amphisbænia*.

Having lately been engaged in a detailed study of the morphology of the skull of the Amphisbænians, of which I shall report in another place, it became necessary to examine *Anniella*, which, according to Cope's latest researches, is considered a member of the Amphisbænians. My material consists of 2 skulls prepared by myself from alcoholic specimens, which were given me by Prof. J. J. Rivers, of Oakland, Cal., and of a completely macerated skeleton of *Anniella pulchra*, (No. 3185, U.S.N.M.), from San Diego, Cal., collected by Dr. J. L. Le Conte. I

\* COPE, E. D.—Synopsis of the families of Vertebrata. Am. Nat., Oct., 1889, pp. 19-20.

† COPE, E. D.—Syllabus of lectures on Geology and Paleontology. Philadelphia, 1891, p. 48.

‡ COPE, E. D.—The Osteology of the Lacertilia. Proc. Amer. Philos. Soc., XXX, May 10, 1892, pp. 215-217, Pl. II, fig. 4; Pl. VI, fig. 43.

COPE, E. D.—On Degenerate Types of Scapular and Pelvic Arches in the Lacertilia. Journ. Morphol., VII, No. 2, p. 240, Pl. XIII, fig. 7. Boston, 1892.

am indebted to Prof. Rivers and Dr. L. Stejneger for the great kindness they have shown me, by furnishing these valuable specimens.

From the study of this material, I reach the following conclusion: *Anniella* has to be placed in a separate family, very close to the Anguidæ, and has its closest relative in *Anguis* itself. Boulenger's opinion is nearest to the truth. Reasons: (1) There is a distinct epipterygoid (columella). (2) There is a well-developed squamosal [supratemporal, Parker and Bettany, Cope]; but the quadrato-jugal [paroccipital, Cope] is absent. (3) The jugal is present, but rudimentary at its upper end, being connected with the postorbital by ligament only. (4) The lachrymal is present. (5) There is a well-developed supraorbital. (6) The caudal vertebræ are segmented, the segmentation being placed in the anterior portion of the centrum. (7) Osteodermal plates are present.

I shall now give a description of the skull and the other most important elements of the skeleton, from which it will be evident that my opinion about the relationship of *Anniella* is the only one which agrees with the facts. Figures will be published in a paper, now in preparation, "On the morphology of the skull of the *Amphisbænia*."

#### OSTEOLOGICAL CHARACTERS OF ANNIELLA.

*The skull.*—The præmaxillary is single, sending a median process between the nasals. There are three processes on the lower side; one median, two lateral ones. The median process extends between the anterior ends of the vomer; the lateral processes are connected with the maxillaries, by which they are embraced on the outer side. The nasals are distinct; they are in connection with the præmaxillary, frontals, maxillaries; they are separated above from the prefrontals by a very slender anterior process of the frontals. There are two frontals, in connection with the nasals, prefrontals, postfrontals, and parietals; the descending processes are strong and meet below, underarching the olfactory lobes. The parietal is single and very large; it is in connection with the frontals, postfrontals, petrosals, squamosals, paroccipitals, and supraoccipital. There is no pineal foramen; but the dark pineal eye is quite distinct in the anterior portion of the parietal, and the pineal fossa is present on the lower side of the parietal. The parietals are bent down strongly. There are two small processes behind close to the median line. The outer and posterior ends of the parietal show short processes, which are placed on the petrosals, and on which the anterior end of the squamosal rests. The supraoccipital is closely united by suture with the parietal. There is a median process and two lateral processes, on each side of the median, all united with the parietal. Two very small vacuities between parietal and supraoccipital, close to the median line, are present. The supraoccipital is connected, besides, with the exoccipitals, paroccipitals, and petrosals. The foramen magnum is bordered by the basioccipital, exoccipitals, and supraoccipital. The condyle is convex, quite simple, and formed by the basioccipitals and exoc-

cipitals. In one of the specimens before me, the sutures between these elements are quite distinct, also the suture between the basioccipital and basisphenoid. The paroccipital processes of the exoccipital are broad, not much developed, connected on the outside with the squamosal and parietal, and touching the posterior slender process of the quadrate. The basisphenoid sends processes on each side backwards, over the basioccipital, joining the epiphyseal process between basioccipital and basisphenoid. The basipterygoid processes of the basisphenoid are well developed. The petrosal shows a long anterior process, which nearly reaches the epipterygoid. The maxillary is in connection with the premaxillary, nasal, frontal, prefrontal, supraorbital, lachrymal, jugal, ectopterygoid, vomer, and palatine. There are 5 maxillary foramina, 2 above and 3 below; the number of teeth is 7, and they show a groove on the anterior and inner side at the top. The prefrontal\* is slender, placed along nearly the whole lateral border of the frontal, separated from the parietal only by a slender posterior outer process of the frontal; the descending process of the prefrontal is well developed. The prefrontal is in connection with frontal, supraorbital, palatine, and postfrontal. The postfrontal is small, in connection with frontal and parietal, and the very small postorbital, which is attached to it at its posterior and lower end. The frontal is therefore completely excluded from the orbit; a condition which is found also in *Chamaeleo*, *Heloderma*, *Pygopus*, and in *Trachysaurus*, *Tyliqua* of the Scincidæ.†

The supraorbital is a large bone, placed above the eye in the anterior region of the orbit; it is in connection with the prefrontal and maxillary as in *Anguis*. The lachrymal is very small, in connection with maxillary, jugal on the outside, and the prefrontal on the inside. The jugal is a slender element; it becomes ligamentous in its upper posterior portion, where it joins the postorbital. It is in connection with maxillary, lachrymal, and ectopterygoid.‡ The conditions of these elements are very much like those seen in *Anguis*.

The squamosal [opisthotic, paroccipital, Cope; supratemporal, Parker and Betany; mastoidien, Cuvier] is a small splint-like bone, standing on the quadrate and connected with the parietal, paroccipital, and touching the petrosal. There is no trace of a quadratojugal (squamosal, Parker; supratemporal, Cope).§

\* Cope says—"The prefrontal is above the eye, and is cut off from the postfrontal by an entrant angle only." Osteol. Lacert., p. 215. Instead of postfrontal it ought to read parietal.

†SIEBENROCK, FRIEDRICH—Zur Kenntniss des Kopfskelettes der Scincoiden, Anguiden und Gerrhosauriden. Ann. K. K. Naturhist. Hofmus., VII, 3, p. 181, Wien 1892.

‡The description of these elements and the figures given by Cope are not correct. He states, p. 186, that the jugal in *Amniella* may include the lachrymal; and, p. 215, "No jugal." No mention is made of the supraorbital. In the drawing it seems to be indicated, but the prefrontal is not figured. All the drawings given on Pl. II are very poor and quite useless.

§ Cope states—No distinct supratemporal [quadratojugal] or paroccipital [squamosal].

The stapes has a very large disc and a short columella; it is placed between the paroccipital, petrosal, and basioccipital.

The vomers are united in the median line, at about three-fourths of their length; posteriorly they diverge. In the middle they show a deep groove, which is bordered on each side by a keel placed on each vomer. Each vomer is pierced by a foramen. In front they are united with the premaxillary, outside with the maxillaries, and behind with the palatines. The maxillary processes are well developed and cover partially the posterior nares. The palatines are separated in the middle line; they are in connection with the vomers, maxillaries, ectopterygoids, pterygoids, and prefrontals. The pterygoids are completely separated from each other. They show three processes, one posterior one attached to the inner side of the quadrate and extending a little behind its posterior border. This process is deeply hollowed out at its lower and inner side. Two processes are directed in front; the inner broad one is connected with the palatines, the outer slender one with the ectopterygoids. The foramen ectopterygoideum (suborbitale) is bound by pterygoid, ectopterygoid, and palatine. The quadrate is simple, hollowed out somewhat externally; it shows a distinct upper and posterior process, which extends above the stapes to the paroccipital and supports the squamosal. The epipterygoid, which was stated to be absent by all authors in *Anniella*, is present; it is a slender, short columellar ossicle, which stands vertically on the pterygoid and nearly reaches the descending process of the parietal. The mandible consists of 5 pieces, articular and supra-angular being ossified. There are 7-8 teeth, which also show the grooves. The hyoid system is very simple, and has been correctly described by Prof. Cope. It consists of a single glosso-basilial, which is divided behind, and gives attachment to a very slender first hyobranchial; more slender than figured by Cope.

*The vertebrae.*—There are 74 presacral vertebrae in two specimens examined by me; 73 in Prof. Cope's specimen. All of these bear ribs, with exception of the two first ones. One specimen had even a cervical rib on the second vertebra, but only on one side. The seventy-fifth vertebra has a simple sacral rib united with the centrum; the seventy-sixth vertebra has the sacral rib distally split, forming a lymphopophysis; the seventy-seventh is of the same form and shows the first chevron, the lateral pieces being not united distally; the seventy-eighth shows only on the right side an indication of splitting at the distal end of the transverse process; the chevrons are not united distally; the seventy-ninth exhibits single caudal ribs, and the chevrons are united distally. At the eighty-first vertebra the transverse splitting of the centrum commences; the split is in the anterior portion of the centrum and cuts off a small anterior portion of the caudal rib. Cope erroneously states the caudal vertebrae are not segmented. I consider the seventy-fifth and seventy-sixth vertebra as the true sacrals, to one of which the rudimentary pelvic arch is attached by ligaments. The

chevrons are placed centrally. There are ten "cervical" vertebræ, showing lower processes, which are placed in the center and contain both catapophyses\* and intercentra.

The neural spines are developed in the tail, but very little; in the dorsal region they are short, vertical ridges, which are somewhat more developed in the cervical region.

*The shoulder girdle and pelvis.*—No trace of a shoulder girdle could be found. The pelvis was represented not only by a rudimentary ileum, as stated by Cope, but also by an ischium and pubis, which are united proximally. The pubis has an obturator foramen. These bones I only found in the macerated skeleton.

*Dermal ossifications.*—By all authors it is stated that dermal ossifications in the skin are absent; this is not correct; they are well developed.

I now give the osteological characters of the family Anniellidæ: Teeth large, few, fang-like, with short, swollen base, and indications of grooves. Palate toothless. Skull approaching the Amphisbænian type; no interorbital septum; parietals suturally united with supraoccipital; petrosal greatly produced in front; an epipterygoid; squamosal present, but small; quadratojugal absent; postorbital arch ligamentous; a supraorbital bone; pterygoids not in contact with basicranial axis, except by the basipterygoid processes; an infraorbital fossa; præmaxillary single; nasal and frontal divided; parietal single; præ- and post-frontal in contact. Caudal vertebræ segmented; osteodermal plates.

The Anniellidæ are in the same relations to the Anguidæ, as are the Acontiidæ to the Seineidæ; but they are still more degenerated, for in the Acontiidæ we still find a very rudimentary quadratojugal.

I shall discuss the relationship of all these degenerate families more fully in my paper on the Amphisbænia.

---

\* I call catapophysis the lower process in the cervicals, to which the intercentra (hypapophysis) are attached; the lower processes in the vertebræ of snakes, for instance, are catapophyses and not hypapophyses.